

Name Key

Gas Unit Practice Test

1. A glass column is filled with mercury and inverted in a pool of mercury. The mercury column stabilizes at a height of 735 mm above the pool of mercury. What is the pressure of the atmosphere?

Almost standard pressure

- a) 0.697 atm b) 0.735 atm c) 0.967 atm
d) 1.03 atm e) 194 atm

- 2-3. Consider three 1-L flasks at STP. Flask A contains NH_3 gas, flask B contains NO_2 gas, and flask C contains N_2 gas.

2. Which contains the largest number of molecules?

- a) flask A b) flask B c) flask C
d) all are the same e) none

3. In which flask do the molecules have the highest average velocity? - *lightest molecules*

- a) flask A b) flask B c) flask C
d) all are the same e) none

4. Gaseous chlorine is held in two separate containers at identical temperature and pressure. The volume of container 1 is 1.30 L and it contains 6.70 mol of the gas. The volume of container 2 is 2.20 L. How many moles of the gas are in container 2?

- a) 11.3 mol b) 19.2 mol c) 0.427 mol
d) 3.96 mol e) none of these

*volume is close to double,
so moles would also be close to double*

5. Body temperature is about 308 K. On a cold day, what volume of air at 273 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?

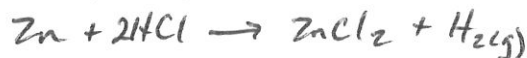
- a) 2.26 L b) 1.77 L c) 1.13 L
d) 3.54 L e) none of these

*Temp & volume are directly proportional.
slightly lower Temp \rightarrow slightly lower volume*

(True False) 11. In the kinetic molecular theory we assume an ideal gas has no mass.

- we assume zero volume, but not zero mass

12-14. Zinc metal is added to hydrochloric acid to generate hydrogen gas and is collected over a liquid whose vapor pressure is the same as pure water at 20.0°C (18 torr). The volume of the mixture is 1.7 L and its total pressure is 0.810 atm.



12. Determine the partial pressure of the hydrogen gas in this mixture.

- a) 562 torr b) 580 torr c) 598 torr
d) 616 torr e) 634 torr

$$0.810 \text{ atm} = 615.6 \text{ torr} = P_{\text{H}_2} + 18 \text{ torr} \quad P_{\text{H}_2} = 597.6 \text{ torr}$$

13. Determine the number of moles of hydrogen gas present in the sample.

- a) 42 mol b) 0.82 mol c) 1.3 mol
d) 0.056 mol e) 22 mol

↓
0.786 atm

$$PV = nRT$$
$$0.786(1.7) = n(0.08206)293$$
$$n = 0.0556 \text{ mol}$$

14. What would happen to the average kinetic energy of the molecules of a gas sample if the temperature of the sample increased from 20°C to 40°C?

- a) It would double. b) It would increase. *- by a little*
c) It would decrease. d) It would become half its value.
e) Two of these.

293 K → 313 K

15. Argon has a density of 1.78 g/L at STP. How many of the following gases have a density at STP greater than that of argon?

- Cl₂ He NH₃
a) 0 b) 1
d) 3 e) 4

NO₂ *- Have greater molar mass than Ar*
c) 2

16. Air has an average molar mass of 29.0 g/mol. The density of air at 1.00 atm and 30.0°C is

- a) 29.0 g/L b) 40.0 g/mL c) 1.17 g/L
d) 1.29 g/L e) 12 g/L

Assume 1 mol

$$PV = nRT$$
$$1 \cdot V = 1(0.08206)303$$
$$V = 24.86$$

$$D = \frac{m}{V} = \frac{29.0 \text{ g}}{24.86 \text{ L}} = 1.17 \text{ g/L}$$

6. Given a cylinder of fixed volume filled with 1 mol of argon gas, which of the following is correct? (Assume all gases obey the ideal gas law.)

- ~~a)~~ If the temperature of the cylinder is changed from 25°C to 50°C, the pressure inside the cylinder will double. - *Not w/ Celsius Temp*
~~b)~~ If a second mole of argon is added to the cylinder, the ratio T/P would remain constant. - *Pressure would double, but Temp is the same*
~~c)~~ A cylinder of identical volume filled with the same *pressure* of helium must contain more atoms of gas because He has a smaller atomic radius than argon.
 d) Two of the above. *'equal volumes have equal moles'*
 e) None of the above.

7. A sample of helium gas occupies 12.4 L at 23°C and 0.956 atm. What volume will it occupy at 40°C and 1.20 atm?

- a) 0.488 L b) 6.28 L c) 12.4 L
 d) 10.4 L e) 17.2 L

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \frac{(0.956)(12.4)}{296} = \frac{1.20 V_2}{313} \quad V_2 = 10.45 \text{ L}$$

8. Which of the following is not a postulate of the kinetic molecular theory?

- ~~a)~~ Gas particles have most of their mass concentrated in the nucleus of the atom. *- True, but not related*
 b) The moving particles undergo perfectly elastic collisions with the walls of the container.
 c) The forces of attraction and repulsion between the particles are insignificant.
 d) The average kinetic energy of the particles is directly proportional to the absolute temperature.
 e) All of the above are postulates of the kinetic molecular theory.

- 9-10. Three 1.00-L flasks at 25°C and 725 torr contain the gases CH₄ (flask A), CO₂ (flask B), and C₂H₆ (flask C). *760 = .954 atm*

9. In which flask is there 0.039 mol of gas?

- a) flask A b) flask B c) flask C
 d) all e) none

$$PV = nRT$$

$$.954(1.00) = n(.08206) 298$$

$$n = .039 \text{ mol}$$

Ideal gas law is the same for all gases.

10. In which single flask do the molecules have the greatest mass, the greatest average velocity, and the highest kinetic energy?

- a) flask A b) flask B c) flask C
 d) all e) none

greatest mass and velocity are mutually exclusive.

KE is the same for all 3.

17. A 4.37 gram sample of a certain diatomic gas occupies a volume of 3.00-L at 1.00 atm and a temperature of 45°C. Identify this gas.

a) ☒ F₂ b) N₂ c) H₂
 d) O₂ e) Cl₂

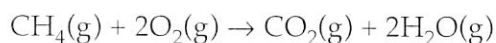
$$PV = nRT$$

$$1(3) = n(0.08206)318$$

$$n = .11496 \text{ mol}$$

$$MM = \frac{4.37 \text{ g}}{.11496 \text{ mol}} = 38.0 \text{ g/mol}$$

18. What volume of H₂O(g) measured at STP is produced by the combustion of 4.00 g of natural gas (CH₄) according to the following equation?



a) 5.60 L b) ☒ 11.2 L c) 22.4 L
 d) 33.6 L e) 44.8 L

$$\frac{4.00 \text{ g CH}_4}{16.034 \text{ g CH}_4} \times \frac{1 \text{ mol CH}_4}{1 \text{ mol CH}_4} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol CH}_4} \times \frac{22.4 \text{ L H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 11.2 \text{ L}$$

19. A 3.31-g sample of lead nitrate, Pb(NO₃)₂, molar mass = 331 g/mol, is heated in an evacuated cylinder with a volume of 1.62 L. The salt decomposes when heated, according to the equation



Assuming complete decomposition, what is the pressure in the cylinder after decomposition and cooling to a temperature of 300. K? Assume the PbO(s) takes up negligible volume.

a) ☒ 0.380 atm b) 0.228 atm c) 0.0342 atm
 d) 1.38 atm e) 49.7 atm

$$\frac{3.31 \text{ g Pb}(\text{NO}_3)_2}{331.22 \text{ g Pb}(\text{NO}_3)_2} \times \frac{1 \text{ mol Pb}(\text{NO}_3)_2}{1 \text{ mol Pb}(\text{NO}_3)_2} \times \frac{5 \text{ mol total gas produced}}{2 \text{ mol Pb}(\text{NO}_3)_2} = .0250 \text{ mol gas}$$

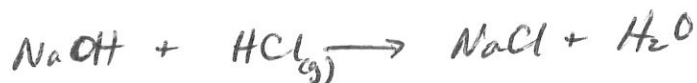
$$PV = nRT$$

$$P(1.62) = .0250(0.08206)300$$

$$P = .380 \text{ atm}$$

20. An excess of sodium hydroxide is treated with 1.1 L of dry hydrogen chloride gas measured at STP. What is the mass of sodium chloride formed?

a) 0.50 g b) 1.8 g c) 2.0 g
☒ d) 2.9 g e) 22 g



$$\frac{1.1 \text{ L HCl}}{22.4 \text{ L}} \times \frac{1 \text{ mol HCl}}{1 \text{ mol HCl}} \times \frac{1 \text{ mol NaCl}}{1 \text{ mol HCl}} \times \frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} = 2.87 \text{ g}$$

21. Which conditions of P , T , and n , respectively, are most ideal?

a) high P , high T , high n
 b) low P , low T , low n
 c) high P , low T , high n
 d) low P , high T , high n
☒ e) low P , high T , low n

22. Order the following in increasing rate of effusion:

F_2 , Cl_2 , NO , NO_2 , CH_4

→ lighter molecules = faster effusion

☒ a) $\text{Cl}_2 < \text{NO}_2 < \text{F}_2 < \text{NO} < \text{CH}_4$
 b) $\text{Cl}_2 < \text{F}_2 < \text{NO}_2 < \text{CH}_4 < \text{NO}$
 c) $\text{CH}_4 < \text{NO}_2 < \text{NO} < \text{F}_2 < \text{Cl}_2$
 d) $\text{CH}_4 < \text{NO} < \text{F}_2 < \text{NO}_2 < \text{Cl}_2$
 e) $\text{F}_2 < \text{NO} < \text{Cl}_2 < \text{NO}_2 < \text{CH}_4$

23. Which of the following properties of a real gas is related to the b coefficient in the van der Waals equation? - volume correction

☒ a) Real gases consist of molecules or atoms that have volume.
 b) The average speed of the molecules of a real gas increases with temperature.
 c) There are attractive forces between atoms or molecules of a real gas.
 d) The rate of effusion of a gas is inversely proportional to the square root of the molecular weight of the gas.

24. A sample of N_2 gas is filled into a flask at a pressure of 200. torr at 25°C . The gas is allowed to effuse through a pinhole and measured at a rate of 4.9 mL/s. An unknown gas is collected into the same container at a pressure of 200. torr at 25°C and it is found that the unknown gas escapes at 14.7 mL/s the rate of N_2 . The molar mass of the unknown gas is:

☒ a) 3.11 b) 252 c) 84.0
 d) 9.33 e) none of these

$$\begin{aligned} \text{Rate 1 } \sqrt{M_1} &= \text{Rate 2 } \sqrt{M_2} \\ 4.9 \sqrt{28.02} &= 14.7 \sqrt{M_2} \\ M_2 &= 3.11 \text{ g/mol} \end{aligned}$$